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Forest Insect and Disease Management

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BIOLOGICAL
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Reduction of Pathogenic Soil Fungi at Mt. Sopris Tree Nursery and Big Sioux Conifer Nursery Using Dowfume® MC-33

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Reduction of Pathogenic Soil Fungi at Mt. Sopris Tree Nursery and Big Sioux Conifer Nursery Using Dowfume® MC-33

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ABSTRACT

The damping-off fungi *Fusarium* spp. and *Pythium* spp. were effectively controlled in two forest tree nurseries by fumigation with Dowfume® MC-33 applied at 400 lb/acre. Fungal populations in the soil recovered significantly two years after fumigation. Fumigation may be required prior to sowing of subsequent crops to control losses from damping-off fungi.

INTRODUCTION

Damping-off fungi, primarily *Fusarium* spp. and *Pythium* spp., are a major concern to the forest tree nursery industry worldwide (Cole et al., 1960; Smith, 1970). Nurseries support enormously valuable crops and each acre of nursery may furnish seedlings for reforestation of 500 to 2,000 acres of resource lands, thus the risk of even small production losses has major implications (Anonymous, 1975). Necessity for timely controls for damping-off diseases is apparent.

Tree nurseries in the Rocky Mountain Region are not immune to losses from damping-off fungi (Landis, 1976) and there have been efforts to reduce these losses (Landis et al., 1976; Gillman, 1977 a, b).

This evaluation reports on results of fumigation studies to control damping-off fungi at the U. S. Forest Service Mt. Sopris Tree Nursery, located in Carbondale, Colorado, during 1978 and 1979 and the South Dakota Department of Wildlife, Parks and Forestry, Big Sioux Conifer Nursery, located in Watertown, South Dakota, during 1978.

MATERIALS AND METHODS

Mt. Sopris Tree Nursery

Mt. Sopris Nursery consists of 22 planting blocks, 15 of which are used for tree production. As of November 1979 all production blocks had been fumigated at least once since 1976. In 1978 blocks 4, 5, 8, and 11 were fumigated and in 1979 blocks 8, 14, 18, and 19 were fumigated.

Soil fumigation was contracted to Hendrix and Dail, Inc., soil fumigation specialists from Greenville, North Carolina. Fumigant was Dowfume® MC-33 applied at 400 lb/acre injected six-inches under the soil and covered by polyethylene for two days. In 1978 fumigation was done in September and in 1979 it was completed by October.

Soil samples to assay for pathogenic fungi were collected just prior to fumigation in 1978 and 1979. Post-fumigation soil samples were taken at least two weeks after the polyethylene was removed.

One additional set of soil samples for 1978 fumigation were taken in April 1979.

Each block sampled was divided by four equally spaced east-west transects - the two end transects were at least five feet from the end of a planting bed. Four equally-spaced sample points were located along each transect. At each sample point, eight soil sample cores were taken within a five-foot radius from the sample point. Sample cores were taken with a 2 cm diameter sampling probe forced through the soil to a depth of six inches. All eight samples were combined in one plastic bag. Thus, 16 samples consisting of 128 subsamples were assayed per treated block.

All pre- and post-fumigation soil samples were returned under refrigeration to the FI&DM lab at Lakewood, Colorado and processed as follows:

Each sample was cultured on selective medium for *Pythium* spp. (Hendrix and Kuhlman, 1965) and *Fusarium* spp. (Nash and Snyder, 1962). Estimates of soil populations were calculated from three replicate plates as propagules per gram (ppg).

Big Sioux Conifer Nursery

Big Sioux Nursery was scheduled for fumigation in 1977, using identical methods as used at Mt. Sopris, in preparation for the nationwide evaluation of Abbott-Pisolithus mycorrhizal inoculum. On September 14, 1977 a pre-fumigation soil sample was assayed (Gillman, 1977); however, the fall fumigation was delayed and rescheduled for May 1978. A second pre-fumigation soil sample was taken the day of fumigation (May 18, 1978). Two subsequent post-fumigation soil samples were taken on May 22, 1978 and September 28, 1978. All samples were assayed in the same manner as samples from Mt. Sopris.

Samples assayed were collected as follows:

The study area consisted of a planting block divided into eight beds. Three beds were divided into five 130-foot-long plots. In each plot a soil sample was taken at three depths (0-5 cm, 12.5-17.5 cm., 25-30 cm) at three randomly selected locations. Each soil sample was the composite of three 2cm-cores taken one-foot apart.

Only the five plots indicated were fumigated and the entire area was sown to ponderosa pine (*Pinus ponderosa* Laws).

RESULTS

Mt. Sopris Tree Nursery

Results of pre- and post-fumigation soil assays for 1978 and 1979 are summarized in Tables 1 through 4. Fumigation in 1978 significantly (P = .05) reduced levels of *Pythium* spp. and *Fusarium* spp. The *Pythium* spp. population increased significantly by spring of 1979; however, it did not return to pre-fumigation levels. The *Fusarium* spp. population did not increase significantly after fumigation, and by spring 1979 the population was still not at 1978 levels.

Fumigation in 1979 significantly (P = .05) reduced populations of both *Pythium* spp. and *Fusarium* spp.

Big Sioux Conifer Nursery

Results of pre- and post-fumigation soil assays for 1978 are summarized in Tables 5 and 6. Fumigation significantly (P = .05) reduced *Pythium* spp. and *Fusarium* spp. populations except at soil depth 25-30 cm. While recovery of pathogen populations to pre-fumigation levels was evident from assays, it was slow.

DISCUSSION

Dowfume® MC-33 was effective in significantly reducing soil populations of *Pythium* spp. and *Fusarium* spp. While total eradication of populations was indicated (under the present sampling and culturing scheme), in all instances population recovery was evident. Recovery was not rapid enough to cause unacceptable seedling damage the first year. Fumigation will probably be necessary, prior to sowing of subsequent crops, for adequate disease control.

TABLE 1. Means by block and time, for 1978 pre- and post-fumigation soil counts (propagules per gram) for *Pythium* spp. from Mt. Sopris Tree Nursery, Carbondale, Colorado.

	Sample Time		
Block	Pre-fumigation Fall 1978	Post-fumigation Fall 1978	Post-fumigation Spring 1979
4	74.2 a,b,c [1/]	0.3 d	3.2 f
5	92.0 a	0.0 d	2.0 f
8	84.8 a,b	0.1 d	47.8 e
11	53.6 c	1.5 d	3.2 f
$\bar{x}$	76.2 g [2/]	0.5 h	14.1 i

1/ Means in vertical columns followed by the same letter are not significantly different (P = 0.05).

2/ Means in this horizontal row followed by the same letter are not significantly different (P = 0.05).

TABLE 2. Means, by block and time, for 1978 pre- and post-fumigation soil counts (propagules per gram) for *Fusarium* spp. from Mt. Sopris Tree Nursery, Carbondale, Colorado.

	Sample Time		
Block	Pre-fumigation Fall 1978	Post-fumigation Fall 1978	Post-fumigation Spring 1979
4	10,183.3 a [1/]	25.0 c	283.3 e
5	7,191.7 b	33.3 c	516.7 d,e
8	8,741.7 a,b	8.3 c	2,100.0 d
11	7,350.0 a,b	175.0 c	291.7 e
$\bar{x}$	8,366.7 f [2/]	60.4 g	797.9 g

1/ Means in vertical columns followed by the same letter are not significantly different (P = 0.05).

2/ Means in this horizontal row followed by the same letter are not significantly different (P = 0.05).

TABLE 3. Means, by block and time, for 1979 pre- and post-fumigation soil counts (propagules per gram) for *Pythium* spp. from Mt. Sopris Tree Nursery, Carbondale, Colorado.

	Sample Time	
Block	Pre-fumigation Fall 1979	Post-fumigation Fall 1979
8	22.8 a [1/]	0.0 b
14	24.5 a	0.0 b
18	7.0 a	0.0 b
19	22.4 a	0.0 b
$\bar{x}$	21.7 c [2/]	0.0 d

1/ Means in vertical columns followed by the same letter are not significantly different (P = 0.05).

2/ Means in this horizontal row followed by the same letter are not significantly different (P = 0.05).

TABLE 4. Means, by block and time, for 1979 pre- and post-fumigation soil counts (propagules per gram) for *Fusarium* spp. from Mt. Sopris Tree Nursery, Carbondale, Colorado.

	Sample Time	
Block	Pre-fumigation Fall 1979	Post-fumigation Fall 1979
8	2,308.3 a [1/]	0.0 b
14	3,066.7 c	66.7 d
18	2,691.7 e	50.0 f
19	3,816.7 g	33.3 h
$\bar{x}$	2,970.9 i [2/]	37.5 j

1/ Means in vertical columns followed by the same letter are not significantly different (P = 0.05).

2/ Means in this horizontal row followed by the same letter are not significantly different (P = 0.05).

TABLE 5. Means, by soil sample depth and time, for 1978 pre- and post-fumigation soil counts (propagules per gram) for *Pythium* spp. from Big Sioux Conifer Nursery, Watertown, South Dakota.

Soil sample depth	Sample Time: Pre-fumigation Sept. 14, 1977	Pre-fumigation May 18, 1978	Post-fumigation May 22, 1978	Post-fumigation Sept. 28, 1978
0-5 cm	100.8 a [1], 1 [3]	38.2 b, 3	0.0 c, 4	0.6 c, 5
12.5-17.5 cm	111.7 d, 1	50.8 e, 3	0.0 f, 4	0.8 f, 5
25-30 cm	50.1 g, 2	30.9 g, h, 3	3.5 h, 4	-- [2]

[1] Means in horizontal rows followed by the same letter are not significantly different (P = 0.05).

[2] Data not taken.

[3] Means in vertical volumns followed by the same number are not significantly different (P = 0.05).

TABLE 6. Means, by soil sample depth and time, for 1978 pre- and post-fumigation counts (propagules per gram) for *Fusarium* spp. from Big Sioux Conifer Nursery, Watertown, South Dakota.

Soil sample depth	Sample Time: Pre-fumigation Sept. 14, 1977	Pre-fumigation May 18, 1978	Post-fumigation May 22, 1978	Post-fumigation Sept. 28, 1978
0-5 cm	3,555.5 a [1], 1 [3]	479.9 b, 3	0.0 b, 4	293.3 b
12.5-17.5 cm	3,582.2 c, 1	533.2 d, 3	0.0 d, 4	160.0 d
20-30 cm	1,333.4 e, 2	213.3 f, 3	186.6 f, 5	-- [2]

[1] Means in horizontal rows followed by the same letter are not significantly different (P = 0.05).

[2] Data not taken.

[3] Means in veritcal columns followed by the same number are not significantly different (P = 0.05).

RECOMMENDATIONS

1. Continue fumigation with Dowfume® MC-33, or a similar product, prior to sowing to prevent seedling losses to pathogenic soil fungi.

2. Soil assays prior to and following fumigation to monitor fumigation effectiveness are no longer necessary since it is clearly demonstrated fumigation significantly reduces soil fungal populations.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

PESTICIDE USE STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key -- out of the reach of children and animals -- and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.

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